selecting observers admirably qualified for this investigation; nor need we fear that the United States Government will be wanting in their accustomed liberality in publishing the Reports on the subject when they are prepared. Nor will the unofficial geologists of the country and private associations be behindhand in contributing to the mass of information gradually accumulating upon the question of the nature and origin of the terrible event.

ON LION-BREEDING[1]

THE Gardens of the Royal Zoological Society of Ireland have become famous among zoological gardens for their breed of lions. While here and there among the zoological gardens of the world a lion cub is born, none save those of Dublin can boast of a period of lion-cub production of nearly thirty years' duration, or of the extraordinary success of the birth of 131 cubs. This being so, we are indebted to Mr. V. Ball for a history of the subject, which has been published in a recent part of the *Transactions* of the Royal Irish Academy. The subject is one of interest in several ways, and the following short abstract of the details will call our readers' attention to it.

In 1855 a pair of lions from Natal were purchased for these Gardens. The exact relationship of these appears to have been unknown, but their first litter was born in 1857. From 1857 to 1885 we find a total of 131 cubs born, of which twenty-one were either born dead or died shortly after birth, and 110 were reared, eighty-six of these latter being sold, greatly to the profit of the Society and to the advantage of very many of the zoological gardens of Europe, Asia, and America. These 131 cubs were the offspring of nine lionesses and four lions; of the latter, one, "Natal," was the father of forty-two cubs; and another, "Old Charley," who was a son of "Natal's," was the father of forty-six; while of the former, one, "Old Girl," who was born in the Gardens in 1859 as one of a litter of five, was the mother of no less than fifty-five cubs, of which forty-nine were reared. This prolific lioness died at the age of 16 years, apparently of old age.

The facts given by Mr. Ball in one of his very carefully compiled tables seem to indicate two periods of the year at which lionesses in a state of semi-domestication produce their young. While the absence of any well-authenticated information as to the period of the year in which lion cubs are born when in a state of nature is quite remarkable, yet Mr. Ball ventures the fairly safe surmise that considering the period necessary for the rearing and education of a cub to be at the least a year, for the cub is often learning to kill its prey when over a year old, it is most improbable that lionesses have more than one litter in a year when in a wild state; but he thinks it probable that the geographical surroundings of the parents may alter this period, and that it may be in the autumn season in the tropics, when the great heats and droughts of summer are over, and in the spring season in more temperate climes, where the summer warmth would be of service to the young offspring; and he very ingeniously speculates that the two periods of maximum production, as observed in the lionesses in the Dublin Gardens, may have been inherited from two corresponding periods, the result of climatal conditions in a wild state. Another remarkable phenomenon comes to light on comparing the curves of production, when modified into curves of conception, with the monthly curves of temperature for Dublin. In doing so, the maximum curve in the one case is found to closely approximate to the maximum curve of temperature, *i.e.* June and July; and the second maximum curve corresponds to the period of lowest temperature, *i.e.* December and January: but it will be remembered that then the animals are kept in well-heated houses, so that this period, as to temperature, may, though the temperature be artificial, be compared to the other, when it is natural.

The cubs when born are noted as distinctly spotted with dark brown on a ground colour which is rather light brown than fulvous; from about one to three months they are perhaps most distinctly defined; and, though along the back the spots are somewhat quadrangular in shape, there is no indication of actual bars or bands.

In reference to the sexes of the cubs, Mr. Ball is able from accurate information to record the sex of 130 of the cubs, and we find 74 were males and 56 females, giving a majority of 14 males in every 100 cubs. This is an interesting and novel addition to our knowledge of the natural history of the large Carnivores.

No lion or lioness lived in the Gardens for a longer period than 16 years, and it seems probable that 12 to 14 years is the average duration of lion life. The cases so often referred to of lions living to an age of 20 to 30, or the case of "Pompey," who died in the Tower in 1760 at the age of 70, stand on no scientific or even reliable evidence.

Under the heading of "The Cause of Success in Breeding," we find some valuable suggestions as to the keeping of these splendid Carnivores; but we searched in vain for the secret of success. Horse-flesh is evidently not dear in Dublin, as the annual cost of the food of an adult lion, being for the most part horse-flesh, only came to 15*l*. in 1885. A series of tables accompanies the memoir, and some illustrations of the cubs of the lioness "Queen," born April 1885, from drawings by Mr. Thomas.

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[1] "Observations on Lion-Breeding in the Gardens of the Royal Zoological Society of Ireland," by V. Ball, M.A., F.R.S., Director of the Science and Art Museum, Dublin, and Hon. Sec. of the Royal Zoological Society of Ireland. *Transactions* of the Royal Irish Academy, vol. xxviii. Part 24, August 1886.

NOTES

AN article in NATURE for May 6 (p. 7) drew attention to the fact that this present year is the tercentenary of the introduction of the potato into England, and discussed some of the points of its history. Apart from the purely historic aspects of the question, "Whence did our potato first come?" it was shown that in connection with the suggestion of cross-breeding to strengthen against disease it is very important to know which is the species that for three hundred years we have been cultivating. With a view to drawing the attention of cultivators to the subject, it is proposed to hold a Tercentenary Potato Exhibition at the St. Stephen's Hall, Westminster, from Wednesday, December 1, to Saturday, December 4, and to appoint one of those days for a Conference, when some of the unsettled questions may be discussed. The Exhibition will consist of four sections:—(1) An historic and scientific collection, to include early works on botany, in which the potato is figured; maps showing the European knowledge of the New World three hundred year ago, and the proximity of potato-growing districts to the ports most frequented; early books on travel and voyages in which references to the potato occur; works and papers in which attempts to define the different species are made; illustrations of the species and varieties; contemporary references to the voyages of Hawkins, Drake, Grenville, and Raleigh. (2) Illustrations of potato disease, and works on the subject. (Sections 1 and 2 will be arranged under the advice of a committee of scientific gentlemen who have consented to give their co-operation.) (3) Methods for storing, preserving, and using partly diseased potatoes, &c. (4) A display of tubers of all the various varieties grown. (In this section gold, silver, and bronze medals will be awarded. Each exhibit must be accompanied by a statement of date of planting, locality, nature of soil, &c.)

MR. JOHN WHITEHEAD, well known to ornithologists for his discovery of a new species of Nuthatch in Corsica, has been travelling in Borneo during the last two years, and has sent home a large collection of birds. Unfortunately the disturbed state of the country in the Brunei district has prevented Mr. Whitehead from accomplishing the chief object of his expedition, the ascent of Kina Balu, and he has therefore been obliged to restrict his labours to the neighbourhood of Labuan and the country round Sandakan. These districts have been well worked for years by Mr. Alfred Everett, Mr. Treacher, Mr. Pryer, and other naturalists, and Mr. Whitehead's collection, although very complete, did not contain anything new to science. He is now travelling in Java, and purposes to explore some of the mountain-ranges in the interior.

MR. GEORGE REID, a well-known contributor to the pages of Mr. Allan Hume's journal, *Stray Feathers*, has just finished a "Catalogue of the Birds in the Provincial Museum, N.W.P. and Oudh, Lucknow." Mr. Reid is the member of the Committee of Management in charge of the Natural History Department of the Lucknow Museum, and the value of the bird-collection depends upon the series which Mr. Reid has himself given to the Museum, his donation amounting to 1287 specimens out of a total of 2646. The Museum appears to possess a very complete collection of birds from the neighbourhood of Lucknow, and it is encouraging to see that Mr. Reid, in re-organising the natural history portion of the Museum under his charge, has recognised the first duties of a local institution, and has commenced by making a good collection of the birds of the province, of which Lucknow is the capital. Mr. Reid will be glad to entertain the idea of exchanges with other Museums.

THE concluding part of the late John Gould's "Supplement" to his "Monograph of the Trochilidæ" will shortly be issued by Messrs. Sotheran. This work, which was left unfinished at Mr. Gould's death, has been completed by Mr. Bowdler Sharpe, who has also nearly finished the great work on the "Birds of New Guinea," which had not long been commenced by the author before he died.

MESSRS. TAYLOR AND FRANCIS will shortly publish a work by Mr. T. Mellard Reade, F.G.S., entitled "The Origin of Mountain-Ranges." In addition to containing a systematic theory of mountain-building, with detailed experimental illustrations, the structure and geological history of the great mountain-masses of the globe will be discussed. The work will also contain many maps and sections of mountain-ranges, and a contoured map of the North Atlantic Ocean, together with numerous sketches of mountain-structure and scenery, from Nature, by the author.

PROF. R. H. RICHARDS, of Springfield, Massachusetts, has invented an ingenious and effective application of the zoëtrope for the illustration of the relation between certain isomeric forms. The apparatus exhibits the gradual passing of a cube into an octahedron, a dodecahedron, &c. It can be used also for exhibiting the growth of hemihedral forms of crystals.

A PROJECT is on foot for tunnelling the "Great Divide." The Divide is the Rocky Mountains, and the point proposed to be tunnelled is under Gray's Peak, which rises no less than 14,441 feet above the level of the sea. At 4441 feet below the peak, by tunnelling from east to west for 25,000 feet direct, communication would be opened between the valleys on the Atlantic slope and those of the Pacific side. This would shorten the distance between Denver, in Colorado, and Salt Lake City, in Utah, and consequently the distance between the Missouri River, say at St. Louis, and San Francisco, nearly 300 miles; and there would be little more required in the way of ascending or descending or tunnelling mountains. Part of the work has already been accomplished. The country from the Missouri to the foot of the Rockies rises gradually in rolling prairie till an elevation is reached of 5200 feet above the sea-level. The Rockies themselves rise at various places to a height exceeding 11,000 feet. Of the twenty most famous passes, only seven are below 10,000 feet, while five are upwards of 12,000 feet, and one, the Argentine, is 13,000 feet. Of the seventy-three important towns in Colorado, only twelve are below 5000 feet, ten are over 10,000 feet, and one is 14,000. The point from which it is proposed to tunnel is 60 miles due west from Denver, and although one of the highest peaks, it is by far the narrowest in the great backbone of the American continent.

AT a meeting on Tuesday of the Committee of the subscribers to the British School of Archæology at Athens, Prof. Jebb said the School had been erected and paid for, Mr. F. C. Penrose had been appointed Director, and a provisional income of 400*l.* a year for three years had been raised; but additional funds were required. Prof. C. T. Newton, in urging the importance of having a great School of Archæology, suggested that there should ultimately be raised a special fund for the payment of the travelling expenses of the students at Athens. On the motion of Prof. Jebb, a Managing Committee was appointed.

ON Saturday last, after six in the evening, several shocks of earthquake were felt in Alsace and many other parts in the nearest Alpine valleys, in the Vosges, and in the Black Forest. At Strasburg there had not been any earthquake for almost 200 years. The direction of the movement was from north to south. Several of the shocks were rather severe.

A TELEGRAM from Halifax, October 14, states that a shock of earthquake lasting ten seconds had been felt at Sydney, Cape Breton Island, Canada.

THE Rev. J. H. Abrahall writes from Combe Vicarage, Woodstock, that on September 30, while near Blenheim Park, walking westwards about 7 p.m., he was aware of a sudden splendour above him on his left. Turning towards it, he saw a meteor moving eastward. It pursued a level path beneath the Milky Way about a sixth of the distance from the zenith to the horizon. It was bigger than Jupiter, and of a yellow hue. A reddish flame curled, crest-like, backward from its top. Its course was slow, and it quenched the light of the stars it passed over. It soon vanished, leaving no luminous train.

WE have already referred to two successive instalments of Mr. Taylor's papers on the aborigines of Formosa, which have appeared in the *China Review* of Hong Kong. The third and last is now before us. It first describes the Pepo-huans, who are really not aborigines at all, but who stand between the savages and the Chinese settlers, speaking the language of both. They are believed by themselves and the other tribes to be the result of mixed marriages between whites and Chinese, who have traded to the country or been wrecked on the coasts, and aboriginal women. They are a simple, harmless, peaceful people. The Diaramocks, who inhabit the mountain-ranges which form the north-western boundary of the Tipuns (already described), are a fierce and intractable race, addicted to cannibalism. Little is known about them, as they hold aloof from other tribes. They are supposed to be the true aboriginal inhabitants of Formosa. There is also said to be a tribe of red-haired savages, living amongst the central mountains, but no authentic information has been gained respecting them. The inhabitants of Formosa generally are described as inquisitive and intelligent. The Chinese have a proverb to the effect that when the savages take to wearing trousers there is no opening left for a Chinaman. The custom of head-hunting which prevails in some districts is mainly intended to prove the valour of the young men. On the whole, Mr. Taylor has given us a large number of details, classified under various tribes, which were not known before.

In the September number of the *Meteorologische Zeitschrift*, Prof. Hann gives the results of many years' observations on the temperatures of the various parts of the Vienna forest. The forest valleys have a considerably lower temperature than the open land outside. This difference is smallest in winter and greatest in summer. But there is no similar effect during the course of the day, for the afternoon difference is not the greatest. It is actually least in the warmer hours of the day, and greatest in the cooler part. In the early morning and evening the influence of the forest in lowering the temperature of the air is greatest.

The last number (vol. lv. Part 2, No. 2, 1886) of the *Journal* of the Asiatic Society of Bengal has for its first paper a list of butterflies taken in Kumaon, a district in the middle portion of the Himalayas, lying between Garhwal and Nepaul, by Mr. Doherty, of Cincinnati, who spent several months towards the close of last year in the expedition. Mr. Doherty's failure in the higher regions bordering on Tibet leads him to advise entomologists that the three summer months are the only good ones for collecting, either on the desert plains of Tibet, or in the deep valleys of the Himalayas sheltered by the outer range from the violence of the monsoon rains. Dr. Barclay contributes two papers—one on a second species of Uredine affecting the Himalayan spruce-fir (*Abies Smithiana*, Forbes), the first being described in the first paper of the present volume; the second paper by the same writer relates also to new species of Uredine parasitic in the deodar (*Cedrus deodara*, Loudon). Mr. Atkinson concludes his six papers on the Indian *Rhynchota*, which have been compiled in order "to provide those who may become interested in this order of insects with some guide to their classification and arrangement, and was at first devoted to the correction of our only English list, but this became so unsatisfactory that it was found better to revise the whole on the basis of Stål's numerous and elaborate essays." The number of species described under each family is: *Cicadidæ*, 115; *Cercopidæ*, 67; *Membracidæ*, 33; *Jassidæ*, 38; *Fulgoridæ*, 204. These figures, Mr. Atkinson adds, could probably be doubled in a few years, for the number of *Jassidæ* alone awaiting examination should add several hundred species to the Indian fauna. Dr. King adds three apparently new Primulas from the higher parts of the Eastern Himalayas to the *Primulaceæ* of Sir Joseph Hooker in his "Flora of British India." Finally M. de Nicéville has a paper "On the Life-History of Certain Calcutta Species of *Satyrinæ*, with special reference to the Seasonal Dimorphism alleged to occur in them."

Another consignment of German carp (*Cyprinus carpio*) is to be imported by the National Fish Culture Association to meet the growing demand for this species, which is superior to its congener of this country. The Association, through its secretary, Mr. Oldham Chambers, has urged upon those possessing disused waters to introduce the carp, both the mirror and leather species, therein. Although the German carp belongs to the same genus as the English, the former is being imported to improve the latter, which have deteriorated in flavour and condition owing to lack of cultivation. The fish will be committed to the charge of the Marquess of Exeter's pisciculturist, who has proceeded to Germany for the purpose of bringing them over, together with other species.

An amusing incident occurred last week at the Colonial and Indian Exhibition Aquarium, where a remarkable raven from the Isle of Mull is now on view. On being fed it is the habit of this bird to hide the remnants of its repast in various parts of its habitat, and exhume them when prompted by hunger to renew the meal. One day a rat invaded the spot, and commenced to excavate for the hidden articles of consumption. Enraged at this proceeding, the raven fell upon the rodent, and gored it to death after a severe struggle on both sides.

Messrs. Whittaker and Co. will issue in the course of next week "On the Conversion of Heat into Work, a practical Hand-book on Heat Engines," by Mr. Wm. Anderson, M.I.C.E.

The additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus* ♂) from India, presented by Mr. T. L. Brewer; a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. Walter C. Horsley; a Bonnet Monkey (*Macacus sinicus* ♂) from India, presented by Mrs. Samuel Lloyd; a Common Squirrel (*Sciurus vulgaris*), British, presented by Miss F. Westrup; two Grey Seals (*Halichærus grypus*) from the Island of Canna, N.B., presented by Mr. R. Thom; a Varying Hare (*Lepus variabilis*) from Perthshire, presented by Mr. T. West Carnie; a Goshawk (*Astur palumbarius*) from France, presented by the Baron D'Epremesnil; a Golden Plover (*Charadrius pluvialis*), British, presented by Mr. G. Smith; ten Common Vipers (*Vipera berus*), British, presented by Mr. C. F. McNiven; two Black-footed Penguins (*Spheniscus demersus*) from South Africa, purchased.

OUR ASTRONOMICAL COLUMN

The Binary Star τ Cygni.—Mr. J. E. Gore (who has taken up this branch of astronomy with great vigour) has published in the *Astronomische Nachrichten*, No. 2749, elements of the orbit of τ Cygni. Using the measures of Dembowski, Burnham, Frisby, and Tarrant, he finds:—

$$\begin{array}{rcl|rcl} P & = & 53{\cdot}87 \text{ years} & \Omega & = & 83^\circ\ 0' \\ T & = & 1863{\cdot}99 & \lambda & = & 205^\circ\ 26' \\ e & = & 0{\cdot}3475 & a & = & 1''{\cdot}19 \\ \gamma & = & 44^\circ\ 40' & \mu & = & -\ 6^\circ{\cdot}68. \end{array}$$

These elements represent the observations fairly well. It must be remembered, however, that the measures only extend over a period of ten years, and the orbit must therefore be considered, as Mr. Gore states, to be provisional only.

The Lick Observatory.—We learn from *Science*, vol. viii. No. 190, that the following plan has been devised by Prof. Holden for the working of the great telescope:—"We mean to put the large telescope at the disposition of the world by inviting its most distinguished astronomers to visit us one at a time, and to give to them the use of the instrument during specific hours of the twenty-four. Each day there will be certain hours set apart when the Observatory staff will relinquish the use of the equatorial to distinguished specialists who will come from the United States and from Europe to solve or to attack some one of the many unsolved problems of astronomy. In this way we hope to make the gift of Mr. Lick one which is truly a gift to science, and not merely a gift to California and to its University."

Comet Barnard (1886 *f*).—Dr. J. von Hepperger has published the following elements and ephemeris for the comet discovered by Mr. Barnard on October 4:—

$$T = 1886 \text{ December } 24{\cdot}3064 \text{ Berlin M.T.}$$

$$\left.\begin{array}{rcl} \pi - \Omega & = & 78^\circ\ 56'\ 20'' \\ \Omega & = & 140\ \ 17\ \ 55 \\ i & = & 93\ \ 33\ \ 52 \end{array}\right\} \text{Mean Eq. } 1886{\cdot}0.$$

$$\log q = 9{\cdot}91236$$

Error of middle place ($O - C$).

$$d\lambda \cos\beta = -\ 8 \qquad d\beta = -\ 1.$$

Ephemeris for Berlin Midnight

1886		R.A.			Decl.		Log Δ	Log *r*	Brightness
		h.	m.	s.	°	′			
Oct.	22	11	16	13	3	57·6 N.	0·2961	0·1434	1·86
	26	11	27	15	4	21·1	0·2747	0·1296	2·21
	30	11	39	16	5	53·2	0·2520	0·1093	2·66
Nov.	3	11	52	28	7	1·7 N.	0·2281	0·0916	3·22

The brightness on October 6 is taken as unity.